Accelerator-Driven Transmutation Technology

The Los Alamos National Laboratory ADTT Update

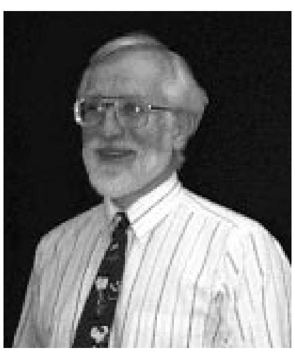
No. 2, October 1994

The ADTT Conference in Review

The International Conference on Accelerator-Driven Transmutation Technologies and Applications was the first to bring together US and foreign efforts in ADTT application areas (waste transmutation, plutonium disposition, energy production) as well as in several diverse technological areas (accelerators, target/blankets, separations, and materials) that make up ADTT systems. Ed Arthur, ADTT Project Office, and Stan Schriber, Director, Accelerator and Operations Technology Division, together planned and cohosted the conference held July 25–29, 1994, at the MGM Grand in Las Vegas, Nevada.

Ed Arthur, Conf. Co-Host

There were 120 technical presentations, approximately one-third of which addressed target/blankets and safety, and one-fourth of which addressed accelerators. The remaining presentations were about equally divided between materials, separations, experiments, and systems.



Stan Schriber, Conf. Co-Host

The meeting also included a panel discussion on the relationship of ADTT and repository approaches for nuclear waste disposal as well as several breakout groups that began identifying issues, development needs, and future steps for technology development. The conference included a tour of the Yucca Mountain site proposed repository, a video address by US Senator Pete Domenici, and a banquet speech by the new president of the American Nuclear Society, Alan Waltar.

There were 210 participants that attended the conference. All major US DOE

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An ADTT Conference Critique

(Wolfgang Barthold is a private consultant who has had more than 30 years experience in the design, safety, licensing, and technology development of the LWR and advanced reactor concepts. He has worked for both the DOE and the NRC. This is his critique of the ADTT Conference)

The potential problems with nuclear weapons proliferation and the concerns about permanent nuclear waste disposal provided the framework for the recently held ADTT conference. There was agreement among the conference participants that accelerator-driven transmutation technologies are a highly effective means for dealing with both problems through plutonium destruction and waste transmutation, respectively. It was also agreed that there is a high level of urgency for addressing these issues.

One way of dealing with the proliferation issue is to burn as much of the weapons-grade plutonium as possible without embarking on a plutonium economy, and to make the “ashes” unusable for nuclear weapons applications. In regard to nuclear waste disposal, it was noted that when the Yucca Mountain repository becomes available, it will barely be capable of accepting the large amount of high-level nuclear waste already accumulated. It should be a major objective to greatly extend the storage capacity of this repository. The transmutation of nuclear waste, especially actinides, together with the burning of plutonium, will greatly reduce the heat production, radioactivity, and toxicity of the waste, thereby increasing (several-fold) the repository storage capacity (see article, p. 4).

The international conference confirmed the technical viability of accelerator-based transmutation technologies for plutonium disposition and nuclear waste transmutation as well as for the production of electrical energy and tritium. Many innovative designs were presented that coupled accelerators to subcritical configurations containing molten salt fuel or solid fuel in coated particle, oxide, or metallic form. It is expected that these designs will achieve a level of safety that equals or exceeds that of advanced reactors. All of the designs that were described are capable of producing electricity for commercial use in addition to meeting the power requirements for the accelerator.

The ADTT systems that were presented are uniquely qualified to burn plutonium to near-zero levels, to effectively transmute nuclear waste, and to minimize or even eliminate the buildup of higher actinides. None of the existing or advanced reactor concepts has these capabilities. The ADTT systems can be designed as efficient energy producers that do not require any fissile fuel as feed material nor produce significant amounts of actinides. The recently lowered requirements for tritium for military use make ADTT systems low-cost tritium producers as well.

The ADTT concepts are unique in that they permit the destruction of weapons-grade (and other grades) plutonium without leading into a plutonium economy or creating plutonium mines at repository sites. The gas-turbine modular helium reactor (GT-MHR) configured as a plutonium destroyer, discussed by General Atomics (GA), does not need any fuel reprocessing (the discharged fuel is already in a suitable form for waste storage). The accelerator-based conversion (ABC) concept for plutonium destruction at Los Alamos does not require reprocessing either (waste is transmuted as plutonium is burned).

The accelerator technology required for ADTT systems has made great advances during the last decade and does not require major developmental work. The blanket designs presented were based on a wide spectrum of technologies, ranging from the already demonstrated high-temperature gas-cooled and molten salt systems, to very advanced molten chloride salt systems with lead chloride cooling—a narrow technology base. With an emphasis on innovation, there came an unevenness in design maturity for different designs. For example, GA's GT-MHR is based on an advanced modular high-temperature gas-cooled reactor design that has already undergone regulatory review and for which a broad technology base exists. The LANL designs were based largely on proven molten-salt technologies, constrained by material, safety, licensing, and economic considerations. However, some of the other designs presented at this conference had only a neutronics-based analysis. More design and analysis work is required to evaluate the different technologies on a consistent basis, with greater attention paid to materials, safety, and licensing issues, as well as mechanical design and design simplification.

None of the international ADTT programs has large amounts of funding at this time. However, impressive experimental facilities already exist in Russia, with major new facilities planned. The LAMPF accelerator facility at Los Alamos is well suited for ADTT technology development and demonstration. There is a close informal collaboration between the different working groups in different countries. The discussions at the conference were open and uninhibited, and innovation was encouraged.

I would have liked to see DOE/DOD presentations on the evolving plutonium disposition and waste storage policies, and discussions of the LWR spent-fuel standard *vis-a-vis* the objectives of effectively destroying plutonium as the ultimate realization of the goal of proliferation security without introducing a plutonium economy.

Accelerator-driven transmutation technologies are new technologies that show great promise not only for plutonium destruction and waste transmutation, but also for electrical energy and tritium production. There is already a world-wide collaboration on the development of these concepts that will greatly reduce overall development costs. Only a relatively low level of funding is required in the US to advance the design concepts and to proceed to a proof-of-principle experiment and a technology demonstration as the necessary next steps in the development of these technologies.

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The ADTT Conference in Review
(Continued from Page 1)

laboratories—Los Alamos, Oak Ridge, Brookhaven, Argonne, Livermore, Sandia, Savannah River, and Hanford—were represented. Industrial participants included Northrop Grumman, General Atomics, Bechtel, Babcock and Wilcox, Litton, Rockwell International, and Kaman Sciences. There were 15 countries in attendance with representatives involved in transmutation technology from Russia, Sweden, France, England, Germany, Italy, Canada, Switzerland, Spain, Belgium, The Netherlands, Austria, Japan, and South Korea.

Conference Highlights

There were two overview papers that set the tone for the potential impact of ADTT on global plutonium and the US geologic storage program. "A Long View of Global Plutonium Management" was presented by R. Wagner of Kaman Sciences Corp., which identified the rearming of the world with nuclear weapons as a major world issue. Given the potential seriousness, Wagner identified fissile nuclear material control (and minimization) as a key international requirement. A presentation made by G. Michaels, Oak Ridge National Laboratory, on the "Potential Benefits of Accelerator-Based Transmutation to the US High-Level Waste Repository" described the proposed Yucca Mountain repository site as a system which would be dynamic (rather than static) because of heat flow and water flow effects resulting from its nuclear waste heat loads. This view is in contrast to the picture of a very stable geological environment where changes over time would be minimal. ADTT would enhance the performance and predictability of the repository by removing actinides which are the major contributor to the heat load problem as well as neptunium and certain long-lived fission products which dominate long-term cumulative dose rate predictions (see article, p. 4).

Selected Technical Highlights

• Carlo Rubbia (CERN, 1984 Nobel prize winner) described his "energy amplifier" concept which uses the thorium-uranium cycle to produce an energy source with minimal long-term waste production. His earlier thermal neutron concepts have now been replaced with a fast-neutron spectrum system.

• G. Bauer from the Paul Scherrer Institute (PSI), Switzerland, described a 1-MW neutron source using water-cooled zircalloy, with plans for a follow-on 5-MW neutron target employing molten metal technology.

• F. Venneri (Los Alamos) described for the first time to a large international audience the ADTT molten-salt-fueled, graphite-moderated systems. The conservative nature and the near-term feasibility of the concept were emphasized. The ADTT accelerator-driven energy producer (ADEP) was described in detail.

• A combined reactor-accelerator driven system based on the modular helium reactor (MHR) was presented by A. Baxter, General Atomics. The addition of the accelerator to the MHR system increases weapons plutonium destruction for this system significantly (from 90%–99.9% for ^{239}Pu, 65%–83% total plutonium destruction).

• Pyroprocessing separations techniques under investigation at Argonne National Laboratory and Rockwell International Corporation were described in papers by Laidler, Ackerman, Johnson, Pierce, and McPheeters from Argonne, and Gay, Grantham, Fusselman, Grimmett, and Roy from Rockwell. Such pyroprocessing techniques, modified to work on fluorides, could prove attractive for treatment of materials in ADTT systems.

• N. Li and R. Camassa (Los Alamos) presented the first experimental and theoretical results outlining a promising fuel clean-up process based on liquid molecular centrifugation, whereby the fission products are continuously removed on-line using the high gravitational fields produced by high speed centrifuges.

• The issue of subcritical system safety began to be addressed quantitatively in a number of papers presented by Rief

(Ispra), Lypsch and Hill (Argonne), Gudowski and Moeller (Royal Institute of Technology), and Bell, Houts, Perry and Venneri (Los Alamos). These result show expected robustness of subcritical systems to reactivity insertions under plausible accident scenarios. Some analyses, however, argued the possibility that active monitoring may still be needed to sense off-normal operation in subcritical systems.

• S. Wender (Los Alamos) outlined the plans for a large transmutation experiment at Los Alamos (see story, p.7), and detailed the status of that effort. In this context, C. Beard (Los Alamos) presented the work in progress aimed at the construction and operation of the first high-power liquid-lead target at LAMPF.

Next ADTT Conference

In summary, it is quite clear that this conference represented a truly international gathering of experts highly interested in ADTT systems. The spectrum of technologies represented and the quality of papers presented was indeed impressive. We look forward to the next ADTT Conference which is planned for Sweden in 1996.

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The Potential Benefits of ADTT to the Repository Program

(A Brief Summary of Gordon Michaels' presentation at the ADTT Conference entitled, "Potential Benefits of Accelerator-Based Transmutation to the US High-Level Waste Repository." Gordon Michaels was recently appointed Director of Nuclear Programs at Oak Ridge National Laboratory)

There are many significant "nonrepository" benefits to be realized from Accelerator-Driven Transmutation Technology applied to burn or transmute the long-lived radioactive fission products and actinide components of spent nuclear fuel and radioactive waste products. However, there are additional benefits to be realized, especially for the US geologic high-level waste repository program.

The original premise for a geologic repository was to emplace wastes in geologic formations that had been stable for long periods of time and could be expected to be stable in the future. Current studies, however, depict more of a dynamic condition in a repository that will first heat up and then thermally cool, potentially changing the hydrology, altering fracture densities and varying groundwater chemistry. Recent advances in our understanding of total repository performance suggests that transmutation may provide very significant benefits to the repository by removing the long-term heat source posed by actinides, and by eliminating the radionuclides (such as ^{237}Np) that dominate the projected environmental releases.

Decay Heat

The heat of decay of the actinides is now expected to play a dominate role in the performance of the potential repository at Yucca Mountain. Given the quantity of spent fuel now considered for Yucca Mountain, a significant volume of the mountain will be raised in temperature above the boiling point of water. In the long term (>100 yrs), it is the alpha decay of various actinides, principally Pu and Am, that will dominate the total heat output of spent fuel. The actinides account for ~80% of the heat generated over the first 1000 years. Beyond 1000 years, actinides contribute ~99% of the additional heat generated in a repository.

Repository Dynamics

The existence of the decay heat from spent fuel is now projected to "massively perturb" portions of the Yucca Mountain site, dominating its hydrology and geochemistry. Coupled hydrothermal-geochemical processes will strongly affect the composition and flow rates of gas and liquid around waste packages as well as the performance of natural barriers underlying the repository and the performance of engineered barriers, such as corrosion and oxidation rates of waste containers. Heat-driven buoyant vapor will transport water to cool regions above the emplaced waste where the water will condense and then be driven downward by gravity toward the repository. This could cause liquid film formation on waste packages, leading to their accelerated failure. The resulting convection between the hot, above-boiling repository and the cooler, subboiling regions will create thermo-hydrologic phenomena not currently found or previously considered in the ambient-temperature site.

Mountain hydrology will change significantly over thousands of years as the mountain rock first heats up after waste emplacement and then slowly cools. It is no longer a matter of characterizing an existing site; our new understanding of the heat effects on repository performance requires us to characterize a thermally-altered site involving highly complex processes that may well make the success of licensing uncertain.

Transmutation Benefits

The original concept of a "cool" repository could be restored by transmutation technology simply by reducing or totally burning the actinide inventories in nuclear waste. The transmutation of actinides has the potential to significantly reduce the long-term source of heat in the repository, thereby reducing the aqueous releases of all radionuclides and eliminating all the undesirable effects in a repository due to high temperatures. Reducing the long-term heat source can also serve to increase the capacity of the facility to store waste, studies show, by as much as a factor of 2 to 4. It also has the potential of significantly reducing the health risk of the repository from all identified release mechanisms and reducing the uncertainties in health risk from phenomena that are not yet completely evaluated or not possible to evaluate. Finally, but no less important, the transmutation of plutonium will virtually eliminate the risk arising from intentional intrusion of a repository for the purpose of recovering material for weapons. ***

Solubility of Radionuclides

In addition to the repository dynamics due to decay heat, the solubility of radionuclides is another temperature-dependent phenomena to be considered. Recent reevaluation of actinide solubility in the Yucca Mountain ground water has yielded values that are three-to-five orders of magnitude higher than that previously calculated. As a result, the actinides are now calculated by the Yucca Mountain Site Characterization Project to dominate releases by the aqueous pathway. Although these releases are within EPA guidelines, the model calculations still omit many phenomena that may increase the magnitude of the calculated releases; e.g., humidity above 100˚C, the effects of steam hydrolysis on the vitrified high-level waste, colloid formation, etc. The most recent report makes note that many potentially important features, processes, and events have yet to be included in the models. For this reason, radionuclide releases from the Yucca Mountain site remain in question.

The "A" in ADTT

(A Brief Summary of The Accelerator Portion of The ADTT Conference, submitted by Thomas Wangler, Accelerator and Operations Technology Division, Los Alamos National Laboratory)

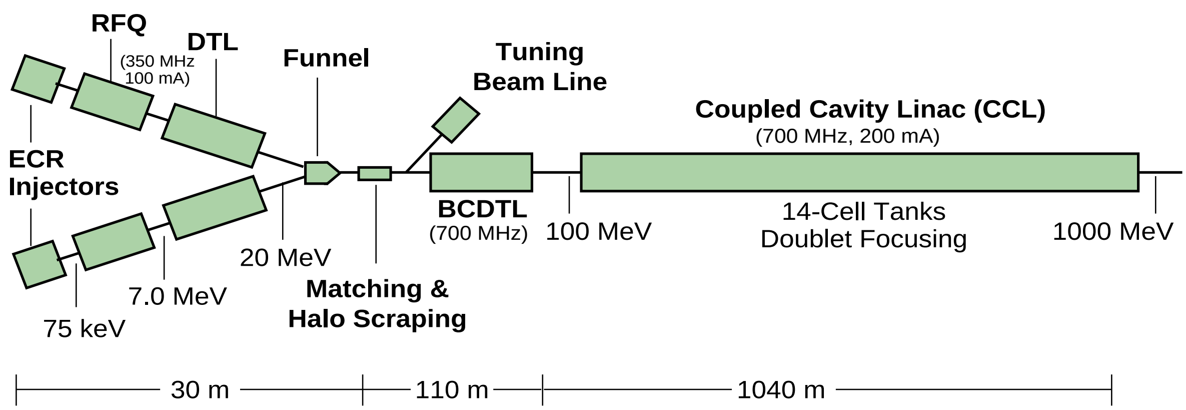
During the past 15 years, many advances have been made in the technology of high-power accelerators, and in the understanding of the beam-physics issues associated with their high-performance requirements. These developments have contributed significantly to the high level of confidence we have in the practicality of the applications—the central point of the international ADTT conference. Even so, there are still accelerator issues that need to be addressed, and the conference provided the opportunity to address them.

Beam requirements for ADTT applications are most often specified with a nominal 1-GeV energy and an average beam current for ATW (accelerator transmutation of wastes) or ADEP (accelerator-driven energy production) ranging from 10–100 mA, depending on different applications and different system concepts. At present, the required beam current for one ATW target-blanket is about 15 mA; however, one may want to irradiate as many as six targets at one facility, requiring a nominal beam current of 100 mA. Beside these basic parameters, other desirable accelerator features include: a) high electrical efficiency, b) low capital and life-cycle costs, and c) high availability and reliability. Availability is generally defined as the fraction of actual running time, excluding the time for scheduled maintenance. Availability of 85%–95% was discussed as a desirable goal.

At the lower beam currents of interest for ATW, the beam-power to ac-power efficiency is less, but could be restored by pulsing the linac (less than 100% duty factor). The beam funnel would not be necessary for a cw ATW linac, but would still be required to handle the higher peak-currents of a pulsed system.

Alternative Accelerator Concepts

A similar rf-linac concept is being studied by the European Spallation Source collaboration, the status of which was described by H. Klein from the University of Frankfurt. Alternative rf-linac concepts involving an extension of the HILBILAC and the use of solenoid focusing throughout the accelerator were also presented, describing the latest thinking from the Moscow Radiotechnical Institute (MRTI). A general conclusion is that there is not yet a consensus between laboratories on the best room-temperature rf-linac design.



Reference RF-Linac Accelerator Design for High Power ADTT Systems

The RF Linac

The room-temperature rf linac, which has been studied thoroughly at Los Alamos, especially for APT (G. Lawrence, et. al.), has undergone several reviews. This continuous-wave (cw or 100% duty factor) high-power linac concept provides a 1-GeV proton beam of 200 mA, yielding a beam power of 200 MW. As shown in the figure above, the high beam current is achieved by using two electron-cyclotron resonance (ECR) ion sources, and by funneling the beams with an rf funnel at 20 MeV. Wall-plug efficiency is around 45%.

Alternative accelerator concepts were presented that might, after more R&D, reduce cost, improve efficiency, or increase reliability and availability. It should be noted that none of the alternative accelerator concepts have been examined with the same level of scrutiny as the room-temperature rf linac.

The induction-linac alternative, for example, was presented by W. Barletta of Livermore (LLL), and the cyclotron alternative was presented by T. Stammbach of the Paul Scherrer Institute (PSI) in Switzerland.

The **induction linac** operation is based on the principle of magnetic induction for the production of an accelerating electric field (as in the betatron). Electrical efficiencies of up to 40% have been achieved. Areas of concern about the induction linac for the ADTT applications include the large space-charge forces at low velocities and the average currents that can be achieved.

The **cyclotrons** may be of interest for lower beam currents. The PSI cyclotron facility operates in a cw mode at 1 mA, and is presently being upgraded to 1.5 mA. The total beam loss rate appears to be comparable to that of LAMPF. How high the current limits for cyclotrons can be pushed is not completely clear, but because of the inherently weaker focusing compared to the linac, especially at low velocities, it is not expected to compete favorably with linacs at high currents. An untested concept that was also mentioned is the separated-orbit cyclotron, which is thought to be capable of accelerating up to 10 mA.

An **electron-driven subcritical reactor** concept was presented by A. Krasnykh of the Joint Institute for Nuclear Research, in Dubna, Russia. This idea, if feasible, would replace the proton accelerator with a simpler and cheaper electron version.

C. Bohn discussed the prospects of a **superconducting rf-linac** for ADTT. By comparison with the room-temperature accelerator, higher accelerating gradients are possible in cw operation, leading to a shorter accelerator, and lower capital and operating costs. However, at the present time for high-current applications, the rf-power couplers limit the gradients. Furthermore, much more experience is needed for high-current operation of superconducting cavities. It is generally agreed that more R&D is needed to achieve the full potential provided by the superconducting option.

Accelerator Issues

The beam-physics talks concentrated on the topics of accelerator design philosophy, beam halo, and the implications for control of beam loss. From the high-availability requirement, it follows that beam losses must be limited to avoid radioactivation that would complicate routine maintenance. The status of some of the recent research on the physics of beam halos was covered in several presentations.

The status of ongoing work on individual accelerator components and subsystems was also described in a number of different talks. The ECR ion-source development at LANL for cw operation is a continuation of earlier work started at Chalk River that is now directed towards higher beam currents. RF power systems were also discussed, pointing out the many advantages of the klystron, such as the experience base, high gain, long lifetime, and high reliability.

An integrated low-energy or front-end test facility operating in a cw mode is necessary for the continued development of accelerator technology, and to demonstrate the long-term reliability. The former Continuous-Wave Deuterium Demonstrator (CWDD) project, a legacy from the SDI program at Argonne, described by G. McMichael, could be a testbed for cw linac engineering, as well as the proposed Accelerator Performance Demonstration Facility (APDF) at LANL, described by D. Chan, intended as a front-end prototype for APT.

The two-hour accelerator breakout sessions provided a valuable forum for a continuing discussion of all these topics. ***

The LAMPF ADTT Experiment

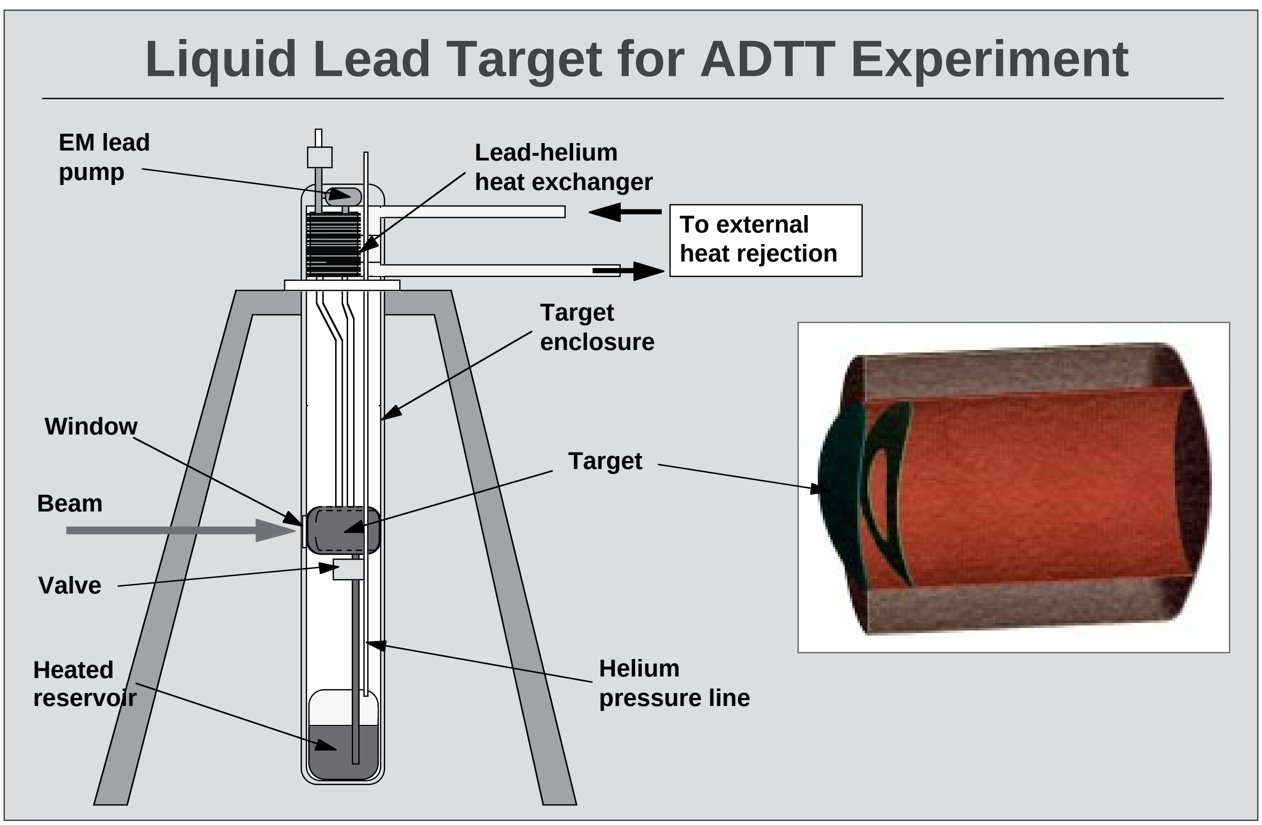
As a crucial step towards realizing an actual ADTT system, we are planning an integrated demonstration experiment at Los Alamos. This experiment will use the full power of the proton beam (800 MW) from the Los Alamos Meson Physics Facility (LAMPF) accelerator and will integrate the operation of the accelerator, the target and the blanket. The experiment will be located in Experimental Area A, just downstream from the pion-production targets.

Staff members from ADTT and from P-, X-, AOT-, TSA-, ESA-, and T-Divisions have joined together to form an experimental design team. The initial efforts of this design team have been focused on the development of a molten lead target. This target is being designed with the philosophy that it will not only work for this experiment at power levels of 1 MW, but will also be expandable so that it would operate in the tens-of-MW power range.

A picture of the target system is shown in the figure below. The target system is designed so that it is modular and can be easily removed from the blanket. In this design, the beam enters the target volume from the side (this is different from the design of the prototype module where the beam enters from the top). This change is required because of beam transport constraints at LAMPF. The molten lead is stored in a reservoir below the target, and will be transferred to the target volume by pressurized inert gas. Once the target is filled, the valve to the reservoir will be closed and the lead will circulate through a lead-to-helium heat exchanger located on top of the target. After use, the lead is allowed to drain into the reservoir and cool.

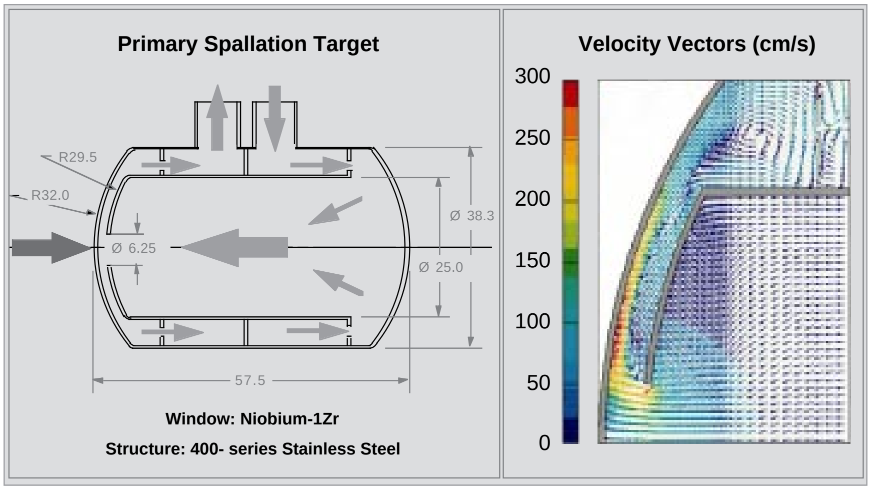
The internal structure of the target volume was designed with particular attention to the cooling of the beam entrance window. The molten lead is pumped through the target volume and forced against the beam window before being returned to the heat exchanger. As can be seen in the figure on the next page, calculations show that this configuration will provide sufficient flow to cool the window. To test the calculations, we are performing a flow- visualization study. In this study, we are making a full scale mock-up of the target volume out of clear plastic. The flow patterns will be simulated with water and dye injection to allow visualization of the flow paths.

We plan to test the various components of the target separately in a test stand that we are building. We will then assemble the target and test the integrated operation of the entire system. Following these activities we plan to install the target in the LAMPF beamstop area and test the operation of the target using the



800 kW LAMPF beam for an extended period. The target will then be removed and examined for any indication of failure.

A similar approach will be taken with respect to the design, testing and operation of the molten salt blanket. ***



Leading the Experimental Program

Steve Wender comes to the ADTT project with a background of experimental neutron and nuclear physics. Starting in Los Alamos 13 years ago, Steve spearheaded the design and construction of the new high-energy neutron production target at the Weapons Neutron Research facility (WNR) at LAMPF. At WNR, Steve was the principle experimentalist, conducting basic and applied neutron physics research experiments. He was also involved in both the operation and the management of the target area.

ADTT Experimental Program Leader Steve Wender

Since joining the ADTT Project, Steve has focused on the development of an experiment that will demonstrate the important aspects of transmutation technology, coupling the accelerator to the target and blanket, and providing the bridge between ideas and reality. Steve is leading an experimental design team of scientists and engineers from a number of different divisions at Los Alamos.

The plans for the LAMPF ADTT Experiment involving both a molten salt blanket and a molten lead target were described in the first issue of *ADTT Update* (July 1994). The initial focus of the experiment is on the development of the molten lead target design, "a technology," Steve says, "that needs to be developed and that will support all ADTT applications." "Several laboratories have been intrigued by the molten lead target concept—a high-power compact target—that has not yet been implemented or realized" (see article on LAMPF ADTT Experiment, p. 7).

In his spare time, Steve makes cast sculptures from molten metals (brass and bronze) in the small foundry he has at home. His "fascination with molten metals" started when he was a student in graduate school at the University of Iowa. "I even met my wife in a sculpture class", says Steve. Steve admits his wife is more artistic, but that he enjoys casting as a hobby. ***

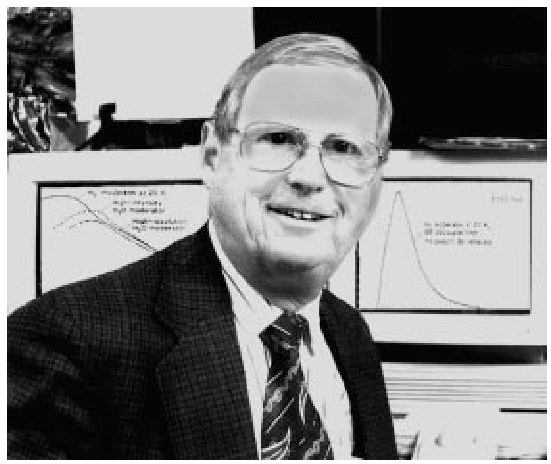
Russians Begin Work on Transmutation

In June of this year, the Board of the International Science and Technology Center (ISTC) met in Moscow and approved the proposal, “A Feasibility Study of Principal Technologies in Accelerator Based Conversion of Military Plutonium and Long-Lived Radioactive Waste.” This is funded at a total of $3.15 million over two years. The program is managed by Dr. Vladimir Kazaritsky of the Institute for Theoretical and Experimental Physics (ITEP) in Moscow. This is the biggest proposal that the ISTC has so far approved and identifies 440 Russian scientists from seven Institutes as participants. The seven Institutes are the Institute for Theoretical and Experimental Physics, the Institute for Experimental Physics (Arzamas-16), the Institute for Technical Physics (Chelyabinsk-70), the Radium Institute, the Institute of Inorganic Materials, the Institute of Power Engineering, and the Institute of Physics and Power Engineering. Los Alamos National Laboratory is named as the single foreign collaborator.

Since the time of approval, the team in Russia has been busy converting their proposal into a detailed workplan that will be submitted to ISTC for final approval before work begins. Sig Hecker, the Los Alamos Director, wrote a strong letter of support to ISTC for the Russian work, choosing to endorse this proposal personally. Many of the participants in this proposal were attendees and major contributors at the recent conference on Accelerator-Driven Transmutation Technology and Applications held in Las Vegas, Nevada. At that meeting, Los Alamos worked closely with the Russian team to understand and support in more detail the proposed workplan. This resulted in the addition of two new partners on the proposal, the Khurchatov Institute and the Institute of Advanced Reactors. The workplan is now in place and is being submitted to ISTC. A kick-off review meeting of the participants will be held in late October at ITEP in Moscow. ***

Leader's Letter

This past year has been one of growing confidence for us in the viability of our technology and in the need for getting on with the near-term demonstration experiment at LAMPF. As I stated in my last letter, the major effort in the ADTT office this year will be to get the message out about our technology. As you have seen already, most of this ADTT Update is devoted to coverage of the Las Vegas Conference. I believe that the meeting served our program and others very well in this respect. It was gratifying to see the initially skeptical reactor vendors start to express serious interest in accelerator-driven transmutation technology as illustrated by the General Atomic proposal for complete burn-up of weapons plutonium with a reactor assisted by an accelerator.



ADTT Project Leader Charles Bowman

Other thrusts for getting out the message are in process. I have just returned from the annual meeting of member states of the International Atomic Energy Agency. This organization is growing in importance as we turn to it increasingly for its role in helping the world to benefit from nuclear science and technology. Director General Hans Blix heard a presentation of mine earlier this year and arranged a scientific session at this IAEA meeting entitled, “Use of High Energy Accelerators for Transmutation of Actinides and Power Production.” In addition to the Los Alamos paper, there were papers from

C. Rubbia (CERN), H. Salvatores (France), I. Chuvilo and N. Rabatnov (Russia), and Yoshida (Japan). The IAEA organizers of the meeting led by Dr. J. Kupitz seemed to be quite interested in planning the next steps for assistance in the development and understanding of this technology and I therefore conclude that they were very pleased with the session.

The initiation of a major ADTT program based at LAMPF requires a US Government decision that ADTT can begin to play a vital role on a time scale comparable to the opening of the first US repository for the disposition of actinide and fission product waste. It appears that US planning thus far has focused on technologies that ultimately depend on geologic storage of the bulk of this material. We believe that it will become clear over the next year that national reliance on underground storage alone would be imprudent. With the apparent termination of the Integral Fast Reactor program at Argonne, accelerator-driven technology is the only means under study in the US by which the "complete" burn-up of these wastes could be achieved. We hope to convince the Government soon that the technology is sufficiently promising to initiate significant scale studies at LAMPF.

We have had a very substantial degree of success in doing that this year with the Accelerator Production of Tritium (APT) program. The present status is that the DOE has endorsed APT, and at this writing, preparations are underway for presentations to convince the Department of Defense of this approach for the maintenance of the Nation's tritium stockpile. Regardless of the outcome of this next round for APT, it is gratifying for us to see the progress over a few years of APT from a technology which was almost dismissed out-of-hand to its selection as the DOE's favored tritium production technology. The transmutation and energy production roles of ADTT are somewhat more technically difficult, but we believe we are on the right track and that this will be recognized soon. Stay tuned.

Charlie

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Steve Wender	Experimental Program

The ADTT Update Edited by Dan Rusthoi

ADTT Calendar

Nov. 10-12, 1994	Int'l Conference on Global Energy Demand in Transition - Washington, DC
Jan. 8-12, 1995	Conference on ADTT and Applications - Albuquerque, NM
Sept. 3-9, 1995	5th Int'l Conference on Radioactive Waste Management and Environmental Remediation - Berlin, Germany
Sept. 11-14, 1995	Global '95 - Paris, France

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